MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

DTC5048 – DIGITAL COMMUNICATION SYSTEMS

(All sections)

7 OCTOBER 2016
3.00 p.m – 5.00 p.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **5** pages (**4** pages for questions and 1 page for appendix).
2. Attempt **ALL** questions.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [25 MARKS]

a) Discuss **three** advantages and **two** disadvantages of digital communication system. [10 marks]

b) Consider a channel with a 1 Mbps capacity and SNR of 60.

(i) What is the upper limit to the data rate that the data can carry? [2 marks]

(ii) Practically, better error performance will be achieved at a lower data rate. Assuming lower data rate is 2/3 of maximum theoretical limit. How many signal levels are needed to achieve this data rate? [3 marks]

(iii) Is it possible to achieve error-free transmission with data stream of 100 kbps? Justify your answer. [3 marks]

c) Figure 1 shows a PCM wave in which the amplitude levels of +1 V and -1 V are used to represent binary symbols 1 and 0 respectively. The code-word used consists of four bits. Find the sampled version of analog signal from which this PCM is derived.

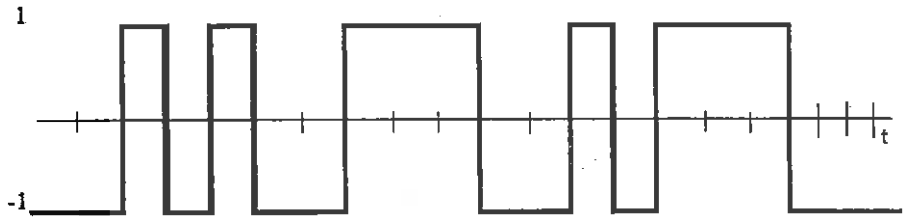

Figure 1

[7 marks]

Continued...

QUESTION 2 [25 MARKS]

a) Explain the major disadvantage in using NRZ encoding. How do RZ encoding and biphase encoding attempt to solve the problem?

[4 marks]

b) Sketch the signal 01001100011 for the following encoding techniques:
(i) NRZ-L
(ii) RZ
(iii) Manchester
(iv) Differential Manchester
(v) AMI

[10 marks]

c) Eye pattern is a simple and convenient tool to investigate the effects of intersymbol and other channel impairment in digital signal transmission.

(i) Define eye pattern.

[3 marks]

(ii) Draw the eye pattern for the following waveform. Indicate best sampling time.

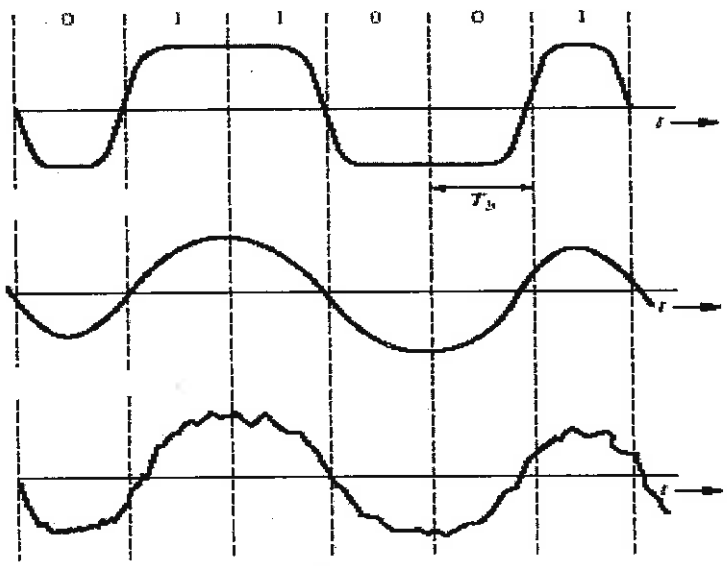

Figure 2

[6 marks]

(iii) List **two** information that can be obtained from eye pattern.

[2 marks]

Continued...

QUESTION 3 [25 MARKS]

a) Define the following terms:
   (i) Bit rate
   (ii) Baud Rate

[4 marks]

b) A certain transmission system transmit 24 000 bps. For each following modulation, calculate the minimum bandwidth required and baud rate for the following modulation techniques and transmission mode:

   (i) Frequency Shift Keying (FSK) with $\Delta fc = 2500$ Hz.

   [2 marks]

   (ii) Amplitude Shift Keying (ASK).

   [2 marks]

   (iii) 8-Phase Shift Keying (PSK).

   [2 marks]

   (iv) 8-Quadrature Amplitude Modulation (QAM).

   [2 marks]

   (v) From the above calculation, which is the **optimum** type of the modulation techniques? Why?

   [2 mark]

c) What is the only advantage using ASK?

[2 marks]

d) Explain **two** primary consideration in design of communication systems.

[4 marks]

d) The root mean square noise voltage at output of a linear system is found to be 1 mV. What is the probability that the instantaneous noise voltage at the output of the system lies between – 3 mV and + 3 mV? Assume that the noise is Gaussian.

[5 marks]

Continued...

QUESTION 4 [25 MARKS]

a) Define the spread spectrum and list **two** types of spread spectrum. Provide **one** application of the spread spectrum.

[6 marks]

b) A pseudorandom number generator uses the following formula to create a random series:

$$N_{i+1} = (5 + 7N_i) \bmod 17 - 1$$

where;
N_i is the current random number
N_{i+1} is the next random number

Find the random numbers.

[10 marks]

c) Consider a CDMA system in which users A and B have codes (-1 1 -1 1 -1 1 -1 1) and (-1 -1 1 1 -1 -1 1 1). Show the output of the decoder of user A at the receiver side if:

(i) User A transmit a data 1 and user B does not transmit.

[3 marks]

(ii) User A transmit a data bit 1 and user B transmit a data bit 1. Assume the received power from both A and B is the same.

[6 marks]

End of Page.

APPENDIX : ERROR FUNCTION TABLE

Error function $\operatorname{erf} x = \frac{2}{\sqrt{\pi}} \int_0^x e^{-y^2} dy$

x	erf x	x	erf x	x	erf x
0.00	0.00000	1.05	0.86244	2.10	0.99702
0.05	0.05637	1.10	0.88021	2.15	0.99764
0.10	0.11246	1.15	0.89612	2.20	0.99814
0.15	0.16800	1.20	0.91031	2.25	0.99854
0.20	0.22270	1.25	0.92290	2.30	0.99886
0.25	0.27633	1.30	0.93401	2.35	0.99911
0.30	0.32863	1.35	0.94376	2.40	0.99931
0.35	0.37938	1.40	0.95229	2.45	0.99947
0.40	0.42839	1.45	0.95970	2.50	0.99959
0.45	0.47548	1.50	0.96611	2.6	0.99976
0.50	0.52050	1.55	0.97162	2.7	0.99987
0.55	0.56332	1.60	0.97635	2.8	0.99992
0.60	0.60386	1.65	0.98038	2.9	0.99996
0.65	0.64203	1.70	0.98379	3.0	0.99998
0.70	0.67780	1.75	0.98667		
0.75	0.71116	1.80	0.98909		
0.80	0.74210	1.85	0.99111		
0.85	0.77067	1.90	0.99279		
0.90	0.79691	1.95	0.99418		
0.95	0.82089	2.00	0.99532		
1.00	0.84270	2.05	0.99626		